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SYNONYMY OF SOME FLEAS FROM WESTERN NORTH AMERICA (SIPHONAPTERA) *

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Continued study of the material in the flea collection at the Dominion Entomological Laboratory at Kamloops, B. C., has emphasized certain mistakes in the literature. Some of the more obvious of these are cited in the following notes.

Doratopsylla curvata obtusata Wagner

Doratopsylla curvata obtusata Wagner, 1929. *Konowia*, 8 (Heft 3):317-318, fig. 2.

Doratopsylla jellisoni Hubbard, 1940. *Pacific Univ. Bull.*, 37 (2):8, figs. on page 9. *New synonym.*

Wagner based his new subspecies on two females collected from *Sorex* sp. at Abbotsford, B. C., March 27, 1928. *D. curvata obtusata* is readily separable from *curvata curvata* Rothschild by the contour of the margin of sternite VII, which is clearly shown in Wagner's fig. 2. Males were unknown to Wagner, but our material proves that they too are easily distinguished from *curvata curvata* by the greater width of process 2 of the clasper, and by the greater length and development of the movable process.

In a description accompanied by a set of excellent figures, Hubbard named *D. jellisoni* from material collected on various species of shrews in Washington, Oregon and California. His illustrations fit Wagner's *curvata obtusata* exactly, and leave no doubt that *jellisoni* is a synonym of the latter.

Our collection contains the following material of this subspecies: Silver Creek (near Hope), B. C., ex *Sorex* sp., 6 ♂, 5 ♀; Chilliwack, B. C., ex *Sorex* sp., 2 ♂, 5 ♀; Huntingdon, B. C., ex *Microtus o. serpens* (Merriam), 1 ♂; Vancouver, B. C., ex nest of *Neurotrichus g. gibbsii* (Baird), 1 ♂, 2 ♀.

Epitedia scapani (Wagner)

Neopsylla scapani Wagner, 1936. *Zeitsch. für Parasitenkunde*, 8 (Heft 3):657, fig. 5 (male).
Epitedia scapani (Wagner), 1940. *Zeitsch. für Parasitenkunde*, 11 (Heft 4):465, fig. 4 (female).
Epitedia jordani Hubbard, 1940. *Pacific Univ. Bull.*, 37 (2):18, fig. on page 9. *New synonym.*

Wagner described *Neopsylla scapani* from two males taken on *Scapanus orarius schefferi* Jackson at Vancouver, B. C., April, 1933. In 1940 he gave additional notes on the species, placed it in the genus *Epitedia* Jordan, and described and figured the female from two specimens supplied by Professor G. J. Spencer of the University of British Columbia, and collected on the University Campus, also from *S. o. schefferi*. I have been able to study one of these, and also a male of the species with the same collection data and identified by Wagner. In addition, we have the following specimens at hand: Caulfeild, B. C., ex *Peromyscus maniculatus* ssp., 4 ♀; Agassiz, B. C., ex *Scapanus orarius schefferi* Jackson 1 ♀; Silver Creek (Hope), B. C., ex *Peromyscus maniculatus oreas* (Bangs), 2 ♀; Silver Creek (Hope), B. C. ex *Sorex* sp., 3 ♀; Chilliwack, B. C., ex *Sorex* sp., 1 ♀; Gleneagles, B. C., ex *Peromyscus maniculatus* ssp. 1 ♀; Cultus Lake, B. C., ex weasel, *Mustella* sp., 1 ♂, 1 ♀; Vancouver, B. C., ex *Neurotrichus g. gibbsii* (Baird) 1 ♂; Chilliwack, B. C., ex *Scapanus townsendi* (Bachman) 1 ♂.

*Contribution No. 2153, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

Doctor Hubbard has erected *Epitedia jordani* from fleas collected on a wide range of small mammals, mostly Insectivora, in Washington and Oregon. The description and diagrams tally perfectly with the descriptions and specimens of *E. scapani*, so that *E. jordani* is surely a synonym.

Nearctopsylla jordani Hubbard

Nearctopsylla jordani Hubbard, 1940. Pacific Univ. Bull., 37 (1).

Nearctopsylla hygini columbiana Wagner, 1940. Zeitsch. für Parasitenkunde, 11 (Heft 4):467, fig. 7. *New synonym.*

Wagner described as a new subspecies, *Nearctopsylla hygini columbiana*, a single male flea collected on the campus of the University of British Columbia, Vancouver, on *Scapanus orarius schefferi* Jackson, December 9, 1938. He mentioned in a letter dated August 2, 1939, that he was describing this flea as new, but his publication did not appear until May, 1940.

C. A. Hubbard described and figured *Nearctopsylla jordani* from fleas collected on *Scapanus townsendi* (Bachman) in Oregon. This publication was mailed in April, 1940.

In the Kamloops collection, beside Wagner's holotype of *columbiana*, we have a single female flea, also from *Scapanus o. schefferi*, taken at Vancouver, B. C. The diagnostic features of both these specimens correspond closely with Hubbard's description and figures of *N. jordani*, so *N. hygini columbiana* appears to be a synonym, the published description of *jordani* having priority by one month.

Megabothris abantis (Rothschild)

Ceratophyllus abantis Rothschild, 1905. Nov. Zool., 12:165, Pl. VI, fig. 10.

Megabothris adversus Wagner, 1936. Zeitsch. für Parasitenkunde, 8 (Heft 6):656, fig. 4. *New synonym.*

Rothschild described *Ceratophyllus abantis* from a series of males only, collected from "Putorius longicaudatus, Canadian National Park, Alberta and from *Microtus drummondii*, Horse Creek, Upper Columbia Valley, B. C." The females have not been described but are known in collections.

In the Kamloops collection we have the following female specimens, found in association with males which are undoubtedly *abantis* (now placed in the genus *Megabothris* Jordan): Waterton Lakes, Alta., ex *Mustela c. cicognani* Bonaparte, 1 ♂, 6 ♀; Cultus Lake, B. C., ex "rats", 1 ♂, 3 ♀. In addition, Mr. Robert Traub of the University of Illinois has loaned the following: Logan Canyon, Utah, ex *Microtus* sp., 1 ♂, 1 ♀.

Wagner separated as new *Megabothris adversus*, described from a single female, collected at Vancouver, B. C., ex *Peromyscus maniculatus* ssp. He states "Die Art steht dem *M. abantis* Roths. sehr nahe, doch ist der Ductus receptac. seminis nicht chitinisiert, wie es nach Jordan, ausser *M. abantis*, auch noch bei *M. immitis* J. und *M. querini* Roths. der Fall ist." That is, Wagner separates *adversus* because there is no chitinisation evident in the duct of the receptaculum seminis, quoting Jordan's authority that this is the case with *M. abantis*, etc. His reference would be the following sentence, extracted from the description of *Ceratophyllus (Megabothris) immitis*†: "Duct of spermatheca for the greater part rather strongly chitinised and therefore conspicuous, being similar to the duct of *S. [sic] abantis* Roths. (1905) and *S. [sic] querini* [sic] Roths. (1905)." This is certainly a *lapsus calami* as there is no evidence of such chitinisation present in *M. abantis*, although there is in the case of *immitis* and *querini*. Mr. Traub had independently noticed this discrepancy in his specimens of *abantis*, and states (in litt.) that other workers in Siphonaptera had run into the same snag. In other words, the species *adversus* was erected on an accidental mis-statement, and is synonymous with *abantis*.

†Jordan, K., 1929. Notes on North American Fleas. Novitates Zoologicae, 35:33-34.

A NEW COLOR FORM OF *POLISTES FUSCATUS* FROM CANADA

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In my introductory study of North American *Polistes* (1940, Jl. New York Ent. Soc., XLVIII, pp. 1-31) I discussed the variation of the yellow markings in *Polistes fuscatus* var. *pallipes* Lepeletier (p. 29). I mentioned specimens with small, free, yellow spots on the disk of the second tergite. Many more wasps of this type were received during the past two years. They are particularly common in Canada, very rare or unknown elsewhere. For this reason and also because this variant is likely to be confused with var. *variatus* Cresson, it seems proper to distinguish it by name.

Polistes fuscatus var. (or subsp.) *laurentianus* new

Female and Worker. Black, practically without ferruginous-red markings (sometimes a few reddish blotches on mandibles, ocular sinuses, outer orbits, clypeus and legs; very rarely on pronotum); antennae russet beneath. Extensively marked with pale yellow as follows: most of mandibles; lower and side margins of clypeus; lower inner orbits; a cross-streak on middle of frons; narrow outer orbits; humeral and hind margins of pronotum; anterior margin of scutellum and of postscutellum; tegulae; a spot in upper corner of mesepisternum; two broad longitudinal stripes on propodeum; broad, somewhat wavy apical margins on tergites 1 to 5 and sternites 2 to 5; an irregular spot on each side of tergite 1, more or less connected with apical margin; a pair of irregular, small or large, usually free, latero-discal spots on tergite 2, rarely somewhat reddish at the edges; sometimes a free spot on each side of tergite 5; tergite 6, except for a longitudinal median black stripe; sometimes a free spot on each side of sternite 2; (very rarely free dots also on the sides of tergites 3 and 4); streaks on coxae, femora and tibiae; and most of tarsi. Wings as in *pallipes*, slightly infuscated and somewhat purplish; veins and stigma russet.

Male. Dorsally similar to the female; ventrally much more extensively yellow, as usual in this sex; clypeus, face and most of sternum and sternites yellow.

Holotype, female, and *allotype*, male, Queen's Park, Aylmer, QUEBEC (C. B. Hutchins). *Paratypes*: ONTARIO: Gull Lake (H. S. Parish); Lake Joseph (K. F. Auden); Ottawa (F. W. L. Sladen); Audrey Falls (D. S. Bullock); Grimsby (F. W. L. Sladen); Harrisburg (F. W. L. Sladen); Bewdley (T. W. Ramm); Rostrevor (A. Gibson); Sudbury; Glen Ross, Hastings Co. (Evans); Trenton (Evans). QUEBEC: Chelsea (A. W. Richardson); Aylmer (J. I. Beaulne); Queen's Park, Aylmer (A. R. Graham); Covey Hill (C. E. Petch); Hemmingford (C. E. Petch); Fort Coulonge (J. I. Beaulne); Kingsmere (R. N. Chrystal); Hull (F. W. L. Sladen); Kirk's Ferry (F. W. L. Sladen); Montreal (J. Ouellet); Rigaud (A. Robert); Trois Rivières (F. Germain). MICHIGAN: Midland Co. (R. R. Dreisbach); Mackinaw Co. (R. R. Dreisbach). VIRGINIA: Alexandria (L. H. Taylor).

Holotype, *allotype* and *paratypes* at Division of Entomology, Department of Agriculture, Ottawa. *Paratypes* also in the collections of J. Ouellet, G. Chagnon, R. R. Dreisbach, U. S. National Museum, Museum of Comparative Zoölogy (Cambridge, Mass.), American Museum of Natural History, Academy of Natural Sciences, Philadelphia, and Department of Zoology, University of British Columbia.

The var. *laurentianus* is near var. *pallipes*, differing only in the presence of a pair of free discal yellow spots on tergite 2. Such spots are found also in var. *variatus* Cresson and var. *montanus* J. Bequaert. Var. *variatus* is more or less ferruginous, particularly on the sides of tergite 2 (surrounding the yellow spots). The areas of *laurentianus* and *montanus* do not touch, and the latter

has large discal lateral spots also on tergites 3 and 4. In the key of my paper cited above, the new variety will run out to couplet 14 (p. 19).

In Ontario and Quebec, *laurentianus* and *pallipes* occur together, apparently in about equal numbers. For instance, the collection of the Department of Agriculture of Ottawa comprises 76 *pallipes* and 65 *laurentianus*. They are found in the same localities under apparently the same ecological conditions. In the United States, *laurentianus* seems to be found only as an accidental variant of *pallipes*, as I have seen only three females among several hundreds of *pallipes* of the Northeastern States.

The relations between *laurentianus* and *pallipes* appear to be analogous to those existing between *Vespa rufa* var. *vidua* and *V. rufa* var. *acadica*, which also occur frequently together in eastern Canada, while *acadica* is either accidental or absent in the more southern part of the range of *vidua*.

The free spots of tergite 2 vary in size. At one extreme, they cover one-third of the length of the tergite, but they are always placed far apart; in the males they are sometimes continued on the sides basad. On the other hand, they may dwindle to minute dots. Finally in some females the dot is present on one side only of the tergite, and such transitional specimens might equally well be called *pallipes*. This is not however, a valid argument against recognizing var. *laurentianus*, unless one is willing to sink all other color forms of *Polistes fuscatus*, for every one of them is connected by similar transitions with one or more of the other varieties.

The presence or extension of the free spots of tergite 2 is not correlated with the size of the wasp. They are equally developed in two females with the fore wing respectively 12 and 16 mm. long.

In my earlier paper I stated (p. 5) that only three forms of *Polistes fuscatus* (Fabricius) were known with certainty from the Dominion of Canada. More extensive material studied since enables me to extend the list to seven.

1. Typical *Polistes fuscatus*. Two females from Ontario (Toronto; Harrisburg) must be referred to the typical form of the species.
2. *P. fuscatus* var. *aurifer* de Saussure. Fairly common in southwestern British Columbia (Vernon; Kaslo; Chilcotin; Okanagan; Kamloops; Salmon Arm; Winslow; Vancouver).
3. *P. fuscatus* var. *connectens* J. Bequaert. Common in certain localities of southeastern Alberta (Medicine Hat; Lethbridge; Manyberries).
4. *P. fuscatus* var. *laurentianus* J. Bequaert. Common in southern Ontario and Quebec.
5. *P. fuscatus* var. *montanus* J. Bequaert. Some specimens from southern British Columbia (Kamloops; Departure Bay; Victoria) are colored almost like the types from Montana; but many more, from the same territory (Kamloops; Departure Bay; Salmon Arm; Vernon; Victoria; Summerland; Powell River; Cowichan Lake) are transitional between var. *montanus* and var. *aurifer*. With British Columbia specimens a series can be arranged leading from true *aurifer* (similar to California specimens) to true *montanus*.
6. *P. fuscatus* var. *pallipes* Lepeletier. Common in southern Ontario and Quebec.

7. *P. fuscatus* var. *variatus* Cresson. One female taken by J. Ouellet at Montreal, Quebec (Sept. 5, 1932), is undoubtedly this form, as it is extensively ferruginous around the yellow spots of tergite 2.

These color forms may be separated as follows (except for transitional specimens).

1. Disk of second tergite without yellow spots (at most apical and side margins yellow) 2.
- Disk of second tergite with a pair of large or small yellow spots, either free or fused with the apical bands 3.

2. Thorax and abdomen black, without or with mere traces of ferruginous blotches, more or less marked with yellow var. *pallipes*.
- Thorax and abdomen black, with extensive ferruginous areas, particularly on pronotum and second tergite, and more or less marked with yellow typical *fusca*.
- Extensively marked with yellow, the discal spots of second tergite very large, either fused with the apical band or separated by a faint line 4.
- Discal spots of second tergite small or minute, always free, separated from the apical band 5.
4. Head black and yellow only. Thorax not or scarcely marked with rufous. Black areas of second tergite as a rule not fringed with rufous. Wings more amber-yellow, stigma and veins rufous var. *aurifer*.
- Head black, yellow and rufous. Thorax with or without rufous blotches on pronotum. Black areas of second tergite usually fringed with rufous. Wings more grayish-yellow; stigma and veins rufous var. *connectens*.
5. Sides of second tergite rather extensively ferruginous, surrounding the yellow discal spots. Pronotum and head usually much blotched with rufous var. *variatus*.
- Ground color of second tergite black, the discal yellow spots not or barely fringed with rufous. Pronotum and head not or scarcely rufous 6.
6. Western. Free discal yellow spots usually large and present on tergites 2, 3, 4 and 5 var. *montanus*.
- Eastern. Free discal yellow spots small, often only on tergite 2, sometimes also on tergite 5 (very rarely traces on tergites 3 and 4) var. *laurentianus*.

I am indebted to Brother J. Ouellet, Mr. Gustave Chagnon, Prof. G. J. Spencer, Mr. R. R. Dreisbach, Dr. O. Peck, the Division of Entomology, Department of Agriculture, and the Department of Zoology, University of British Columbia, Vancouver, for most of the material on which the present paper is based.

AN APPARENTLY UNDESCRIPTED *GRAPтолITHA* FROM BRITISH COLUMBIA WITH NOTES (LEPIDOPTERA)*

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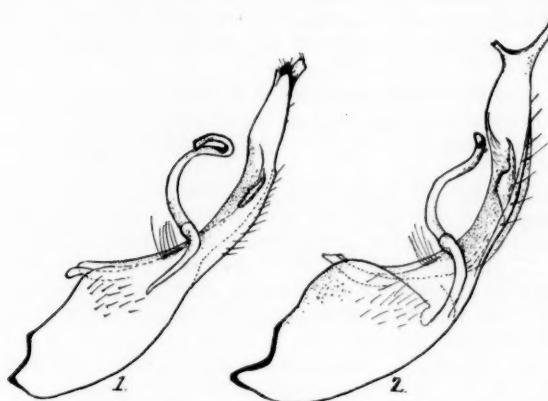
In checking over the material in our collection under *Graptolitha torrida* Sm. in connection with slides of the male genitalia I discovered that apparently two species were involved which could be readily separated on genitalic characters.

Torrida Sm. was described (1899, Jour. N. Y. Ent. Soc., VII, 228) from 10 specimens, the habitat being given as 'Pullman, Washington, October, March April (C. V. Piper); Garfield Co., Colorado, 4,000 ft. (Bruce); N. W. British Columbia (Ottolengui); Soda Springs, California, October 16 (Hy. Edwards)'. No type was designated. The following year in his revision of the genus (1900, Trans. Am. Ent. Soc., XXVII, 11 and 36/8) Smith discusses the species at greater length, with 20 specimens before him and the new locality 'Glenwood Spgs., Colo., October, March and April (Barnes)' added to the previous list of localities; he also gives crude but recognizable figures of the male clasper (Pl. II,

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figs. 23 and 24) and a very dark figure of the moth (Pl. V, fig. 31), no locality for this latter being cited. In his preliminary discussion (p. 11) he states that '*torrida* is blue-gray except for the reddish flush in the reniform' and again that 'the genitalia of the male resemble those of *unimoda* in the *notched tip*' (the italics are mine). Later (p. 37) he mentions variability 'in the amount of contrast and the relative brightness of the maculation'. Again there is no definite designation of type. In the Barnes and McDunnough 'Contributions' Vol. II (1) Pl. XII, fig. 5 a male of *torrida* from Pullman, Wash. which was said to agree with two cotypes in Coll. Barnes was figured and on Pl. XIII, fig. 11 a female from Duncan, Vancouver Is., B. C. was figured under the same name, probably erroneously.

As there is great likelihood that Smith's type series contained specimens of both the species at present under discussion and that furthermore no type



Male claspers of (1) *Graptolitha torrida* Sm. (2) *G. pertorrida* McD. (Holotype).

designation was made by the author, I believe I am justified in tying down the name *torrida* Sm. to the species with male genitalia similar to Smith's figure 23. This action involves a rather delicate point of nomenclature; it was Smith's custom to label his series, 'Type ♂', 'Type ♀', and the balance 'Cotypes', but due to the war there is no possibility of obtaining data as to which specimen actually bore this 'Type ♂' label nor as to whether the genital figure was made from such type. In other words I am laying greater stress in the determination of the species on published data than on a specimen bearing a 'Type' label (but not designated as type) which may or may not agree with such data.

Of *torrida*, as above restricted, there is a good series of both sexes before me from Vineyard, Utah (Spalding) and a single female from Medford, Oregon. The primaries are a light blue-grey with rather distinct maculation of the usual type and with definite rusty shades both above the basal dash and within the reniform; the white area at base of costa is quite noticeable.

The species definitely belongs in the *laticinerea* group; not only do the males show no hair-pencils at the base of the abdomen but in the genitalia the apex of the uncus is bifid, the lateral edges being produced to fine points at right angles to the general plane of this organ. The juxta is also bifid terminally, the two rounded apices being separated by a small V-shaped incision. The clasper is of the same general type as found in other members of the group, with well-developed and moderately enlarged sacculus, from the apex of which

the usual sinuate harpe arises and projects over the costal edge of the clasper; beyond this the clasper is narrow and bent considerably upward, bearing near the ventral edge a raised chitinous ridge with dentate edge which apparently varies in size in different individuals. The apical portion of the clasper is characteristic; it consists of a flat, irregularly rounded chitinous projection on the ventral side (lower side when viewed from within) from the base of which a raised and slightly setose cone of chitin projects inward. When flattened down this would give the appearance of the 'notched tip' of Smith's description and would not be greatly at variance with his figure 23. A reference to my figure should make this clear.

In a series from several localities in British Columbia I find that the male clasper differs in two important points, as well as in other minor distinctions, from that of *torrida*. Firstly, the sacculus shows a much stronger rounded costo-basal projection and secondly, the apex of the clasper is broadly and flatly bifid with a long curved ventral prong and a shorter, blunter, costal one; there is more resemblance to that of *laticinerea* Grt. than to *torrida* Sm. in this respect. As no name seems available I characterize it as follows:

Graptolitha pertorrida n. sp.

Very similar to *torrida* in size and maculation. The color of thorax and primaries is of considerably deeper blue-gray and the maculation of forewing is heavier and somewhat better defined, especially in the median area. While still present, the brown shades above the basal, black dash and in the reniform are not so prominent as in *torrida*. Male genitalia as per figure.

Holotype—♂, Lillooet, B. C., Oct. 6, 1927 (A. Phair); No. 5340 in the Canadian National Collection, Ottawa.

Allotype—♀, same data.

Paratypes—1 ♂, Lillooet, B. C., 1940 (A. Phair); 2 ♀, Salmon Arm, B. C., Sept. 9, 1935 (Host, Apple) (A. A. Dennys), Mch. 20, 1915 (W. A. Buckell); 2 ♂, 2 ♀, Quamichan, Vanc. Is., B. C., Mch. 23, 26, 1908, Sept. 28, 1900 (G. W. Taylor) (ex Coll. Wolley-Dod); 1 ♂, Duncan Dist. Vanc. Is., B. C., Apr. 9, 1903; 1 ♀, Wellington, Vanc. Is., B. C., Apr. 8, 1904 (G. W. Taylor) (ex Coll. Wolley-Dod).

In this connection I would further note that I have three worn specimens (1 ♂, 2 ♀) before me from Glenwood Spgs., Colo. (ex Coll. Barnes), probably part of the same lot as Smith examined in 1900. The male genitalia show the same bifid apex of the clasper but the costal bulge of the sacculus is not so prominent. Such specimens have been distributed by Barnes as *torrida* but are certainly not this species as at present restricted. They may represent a distinct race of *pertorrida* but without more and better material I offer no opinion. Finally I have separated out one male and three females from Vineyard, Utah, the male of which has the *pertorrida* type of genitalia. These specimens are much grayer than my Utah *torrida*, lacking practically all blue tinges and almost all the brown shades; the basal black dash is fine and extends well beyond the oblique shade defining outwardly the pale costo-basal area; the inward angulation of the geminate t. a. line on vein 1 seems somewhat stronger than in *torrida* and the t. p. line is not so well-defined, being obsolescent (some *torrida* specimens also show this). They seem to bear considerable resemblance to the Texan *laceyi* B. & McD. as figured in the 'Contributions' Vol. II, Plate XII, fig. 3 but, if my memory serves me rightly, this should be a still paler gray species, possibly the same as *puella* Sm. (vide Contr. IV (2) '01). Until the status of these two names is cleared up I leave this Utah form standing nameless.

THE USE OF FRASS IN THE IDENTIFICATION OF FOREST INSECT DAMAGE*

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The forest entomologist is often called upon to inspect insect defoliation late in the season at a time when the feeding stage of the defoliator is no longer present in the trees. In such cases, several criteria may be used in determining the insect responsible for the injury and the more evidence which can be gathered, the more confidence one may have in attributing the injury to a certain insect species. If the frass of different forest defoliators can be identified, then the nature of the frass on the ground under the trees or entangled in webs in the trees may be used to corroborate or refute other evidence as to the insect

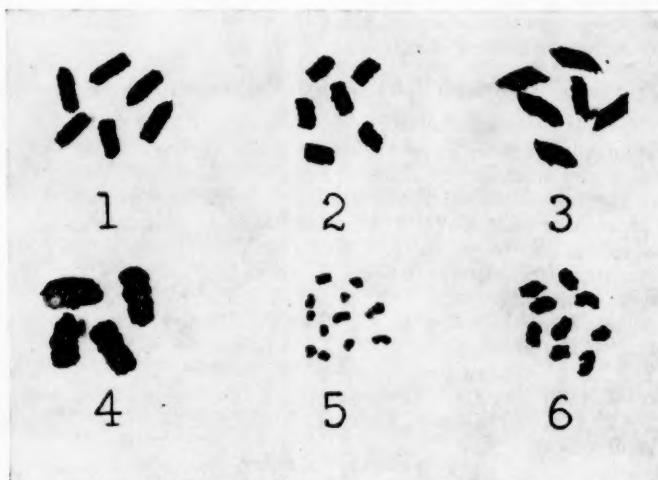


Fig. 1. Frass Pellets. Approximately 2X.

1. Unknown species of Pamphiliidae. Note relatively fine texture and elongate appearance characteristic of members of this family on spruce.
2. *Gilpinia hercyniae* (Htg.), showing parallel transverse arrangement of needle particles and more or less oblique excision of ends common to the Diprionidae.
3. *Neodiprion lecontei* (Fitch) from pine showing the characteristics of the Diprionidae more pronounced than in No. 2.
4. *Panthea acronyctoides* Wlk., illustrating the typical constrictions in the pellets.
5. *Peronea variana* Fern. Note the nearly spherical shape of many of the pellets.
6. *Semiothisa granitata* Gn., illustrating the coarse texture and the irregular arrangement of large needle particles characteristic of the Geometridae.

responsible for the damage. In some cases, in fact, frass may provide the only apparent clue to the identity of the defoliator.

It should be mentioned that this is not the only use which may be made of frass in forest insect investigations. In the course of population studies on the European spruce sawfly, *Gilpinia hercyniae* (Htg.), during the past four years, the writer (4) found that the periodic measurement of frass drop under spruce trees provides the best method of measuring feeding activity and deriving trends of larval population during one or more seasons. The use of frass in rapid insect survey work has been mentioned by Balch (1), who used the amount of frass as one of the criteria for classifying infestations. A more recent paper

by Hodson (2) indicates the usefulness of frass in studying infestations of the forest tent caterpillar, *Malacosoma disstria* (Hbn.). Monro (3) describes experiments with a "caprometer" which was used principally to determine the effects of climatic factors on the feeding activity of the pine sawfly, *Diprion simile* (Htg.). With these exceptions, however, the study of frass drop has not received the attention on this continent which is warranted by its usefulness. A considerable amount of work has been done in Russia and Germany, where investigators have reported that it is possible to determine the species, the stage of development, and the density of the larval population from an examination of frass collections. The decline in the rate of frass drop after the application of direct control measures provides an index of the degree of control effected by different practices.

From the foregoing it will be apparent that keys facilitating the identification of frass would be useful not only in the identification of defoliation injury, but also in studies of larval populations by means of frass collections. In working with a particular species of defoliator, it will be necessary to make sure that no appreciable amount of frass from other species is included in the measurements.

In the course of the larval population studies on the European spruce sawfly by means of frass drop measurement (4), the writer has had occasion to examine the frass of a number of defoliators feeding on spruce in central New Brunswick. It was noticed that the frass of certain groups, such as the Diprionidae and the Geometridae, had certain characteristics common to the group. Furthermore, a closer examination indicated that specific differences existed which were sufficiently reliable in many cases to permit the identification of the species from an examination of the frass of the mature larva. The texture, shape, and size of the frass pellets are the main characters which may be used in their identification. The epidermis of spruce needles is apparently indigestible and the arrangement of pieces of epidermis in the pellets is also of diagnostic value. Colour is unreliable, since it is affected by exposure to weather. For instance, the frass of *Gilpinia hercyniae* is green when ejected but turns reddish brown after exposure for a number of days.

The frass key presented here has been prepared to illustrate the method of identifying a number of the common spruce defoliators from an examination of the frass pellets. Due to the fact that it is far from complete for most spruce stands, the key itself will be useful mainly in indicating some of the characters which may be used in distinguishing the frass of different insect species. Whether the key can be expanded to include all spruce defoliators, or whether similar keys can be prepared for other host species, the writer is not prepared to state. However, the examination of the frass of several pine defoliators suggests that a similar key would be possible for defoliators of that host. The key here presented has been tested by several persons and found to work quite satisfactorily. Difficulty has been experienced by some, however, in distinguishing the frass pellets of different species of Geometridae since they are very similar in shape and texture and can be separated only by small differences in size. Whether such small differences in size will hold in other localities, or under adverse feeding conditions, will have to be ascertained.

The photograph (fig. 1) may be useful in separating some of the main groups in the key, since relative degrees of texture are difficult to define verbally. Where measurements are given, they apply to the larger pellets produced by larvae in the last feeding instar. A good hand lens or binocular microscope of low power and a millimeter rule will be useful in using the key, or in expanding it to include a wider range of species.

FRASS KEY FOR CERTAIN SPRUCE DEFOLIATORS

1a. Texture of pellets fine to moderately coarse; small needle particles may be recognized in either regular or irregular arrangement in the pellets but are imbedded in a matrix which gives the pellets a comparatively regular outline.

2a. Pellets about 3 times as long as thick; texture relatively fine; silken threads often present among the pellets (2 spp. taken from spruce) **PAMPHILIIDAE**

2b. Pellets less than 3 times as long as thick; texture fine to moderately coarse.

3a. Pellets only roughly cylindrical in shape, usually more or less rhombic; parallel transverse grooves present on two sides of the pellets due to parallel arrangement of needle particles; pellets usually cut off more or less obliquely at one or both ends **DIPRIONIDAE**

4a. Pellets larger, about 2 mm. long and 1 mm. wide *Gilpinia hercyniae* (Htg.)

4b. Pellets smaller, less than 2 mm. long and 1 mm. wide *Neodiprion abietis* Harr.

3b. Pellets cylindrical or spherical in shape; neither marked with parallel transverse grooves nor cut off obliquely at the ends.

4a. Pellets greater than 2 mm. in length.

5a. Pellets with a definite constriction in the middle, or often with two constrictions *Panthea acronyctoides* Wlk.

5b. Pellets without a definite constriction *Feralia jocosa* Gn.

4b. Pellets less than 2 mm. in length.

5a. Pellets mostly roughly spherical in shape, or if elongate then with a constriction in the middle suggesting the cohesion of two of the spherical particles. Silken threads usually present *Peronea variana* Fern.

5b. Pellets mostly cylindrical.

6a. Pellets relatively fine in texture; usually only fine needle slivers can be recognized *Pikonema alaskensis* Roh. and *P. dimmockii* Cress.

6b. Pellets considerably coarser in texture; irregular arrangement of fairly large needle particles.

7a. Pellets larger, almost 2 mm. in length *Archips fumiferana* Clem.

7b. Pellets slightly smaller, usually not greater than 1½ mm. long *Elaphria versicolor* Grt.

1b. Texture of pellets coarse; pellets appear to consist of large pieces of needles which are stuck together irregularly at different angles; no matrix is apparent between the needle particles **GEOMETRIDAE**

2a. Pellets mostly 2 mm. or greater in length.

3a. Pellets slightly greater than 1 mm. in width *Caripeta divisata* Wlk.

3b. Quite similar to the preceding but pellets usually slightly less stout, mostly not over 1 mm. in thickness *Elloptia fiscellaria* Gn.

2b. Pellets less than 2 mm. in length.

3a. Less than 1 mm. in thickness *Hydriomena divisaria* Wlk.

3b. Larger, 1 mm. or greater in thickness.

4a. Slightly greater than 1 mm. in thickness *Semiothisa granitata* Gn.

4b. Not greater than 1 mm. in thickness *Nepytia canosaria* Wlk.

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**FURTHER NOTES ON MARITIME COLEOPHORIDAE
(LEPIDOPTERA)***

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Since the publication of my paper dealing with the Coleophoridae of the Maritime provinces (1940, Trans. Roy. Soc. Can. Sec. V, pp. 53-68) I have continued my studies in the group during field work in these provinces in 1940 and 1941. In 1940 cases of several of the *Juncus*-feeders were found to be abundant on both *Juncus littoralis* and *J. compactus* along the north shore of Prince Edward Island in the Canadian National Park area. Brought back to Ottawa they failed, however, to produce adults the following spring, and, in consequence, I decided to time my visit to the same area in 1941 to coincide with the time of flight of the adults—late June and early July. Excellent results were obtained, first at Bathurst, N. B., where a short stop was made (June 24-26), then in the vicinity of Caraquet, N. B. (June 27), but more particularly in the Brackley Beach region of Prince Edward Island (June 30-July 15) where practically all the known *Juncus*-feeders were abundant. Besides this group two other species were obtained during the course of the Insect Survey which form new records for the Dominion; the following notes deal more particularly with certain of these species.

***Coleophora kearfottella* B. & Bsk.**

Coleophora kearfottella Barnes & Busck, 1920, Contr. N. Hist. Lep. N. Am. IV (3) 244; Heinrich (in Forbes, Lep. N. Y.) 1924, Mem. 68, Corn. Agr. Exp. Sta., 207, 213.

The curious and very characteristic cases of this species were first found on some dwarf bushes of *Salix discolor* bordering the edge of a swampy area back of the sand dunes at Brackley Beach, P. E. I. Later more cases were found on willows growing along the country roads further inland. The cases are difficult to find, being frequently attached to the twigs, but are apparently not uncommon; mortality among the larvae was very high, due largely to parasitism and only one adult emerged from about 20 cases. The record is a new one for Canada.

***Coleophora viburnella* Clem.**

Coleophora viburnella Clemens, 1861, Proc. Ent. Soc. Phil. I, 79; Braun., 1919, Ent. News, XXX, 110.

Coleophora viburnella Heinrich (in Forbes, Lep. N. Y.) 1924, Mem. 68, Corn. Agr. Exp. Sta., 208, 216.

A single case of this species was found at White Point Beach, N. S., on a leaf of *Viburnum cassinoides* in 1936, but nothing emerged the next year; in 1941 the reddish-brown cases with their curious wing-like projection were

*Contribution No. 2188, Division of Entomology, Science Service, Department of Agriculture, Ottawa.

common in August on the same plant in the vicinity of Baddeck, Cape Breton Island. Few of the cases were found on the leaves; they were mostly adhering to the twigs and stems of the bushes and, in consequence, easily overlooked. Brought back to Ottawa the larvae continued feeding well into September—in fact until no more leaves were available; they attached themselves for hibernation either to leaves or stems or even the sides of the container. So far only two specimens have emerged (one an undeveloped male); the single perfect specimen shows a mouse-gray color terminally on the primaries rather than the straw or coppery color mentioned by Heinrich but as the cases and food-plant coincide with both Clemens's and Braun's descriptions I am presuming this difference to be merely varietal. The record is new for Canada.

Coleophora glaucicolella Wood

Coleophora glaucicolella Wood, 1892, Ent. Mo. Mag., 172, Pl. IV; Waters, 1928, Ent. Mo. Mag., 50.

Coleophora ciliaeochrella McDunnough (nec Chambers) 1940, Trans. Roy. Soc. Can., Sec. V, 54.

Following a doubtful determination of Walsingham's I referred in my previous paper to this species as *ciliaeochrella* Cham. Since then, through the kind offices of Mr. Bainbrigge Fletcher, I have received authentic English material of *glaucicolella* Wood and find that our Canadian specimens agree in maculation, genitalia and larval cases with the English ones. On the other hand a more careful study of Chambers' original description of *ciliaeochrella* leads me to believe that this name cannot possibly apply to the *Juncus*-feeder as has been done in the past. This description reads 'Silvery white, becoming gradually tinged with reddish ochreous to the apex of primaries, the ciliae of which are distinctly reddish ochreous; antennae alternately annulate with white and brownish yellow. Al. ex. 5 lines. The tuft on the palpal joint is very small'. The color of the present species is certainly not 'silvery white', being more of a light cream-color; nor are the apical area and the fringes of primaries 'reddish ochreous' but rather fawn-brown. The antennae are also not annulate with 'white and brownish yellow' except partially on the underside. To my mind the description would apply much better to some species allied to *gaylussaciella* Heinr. than to our *Juncus*-feeder, and until Chambers' type (if existent) can be studied I prefer to use Wood's name which is definitely applicable.

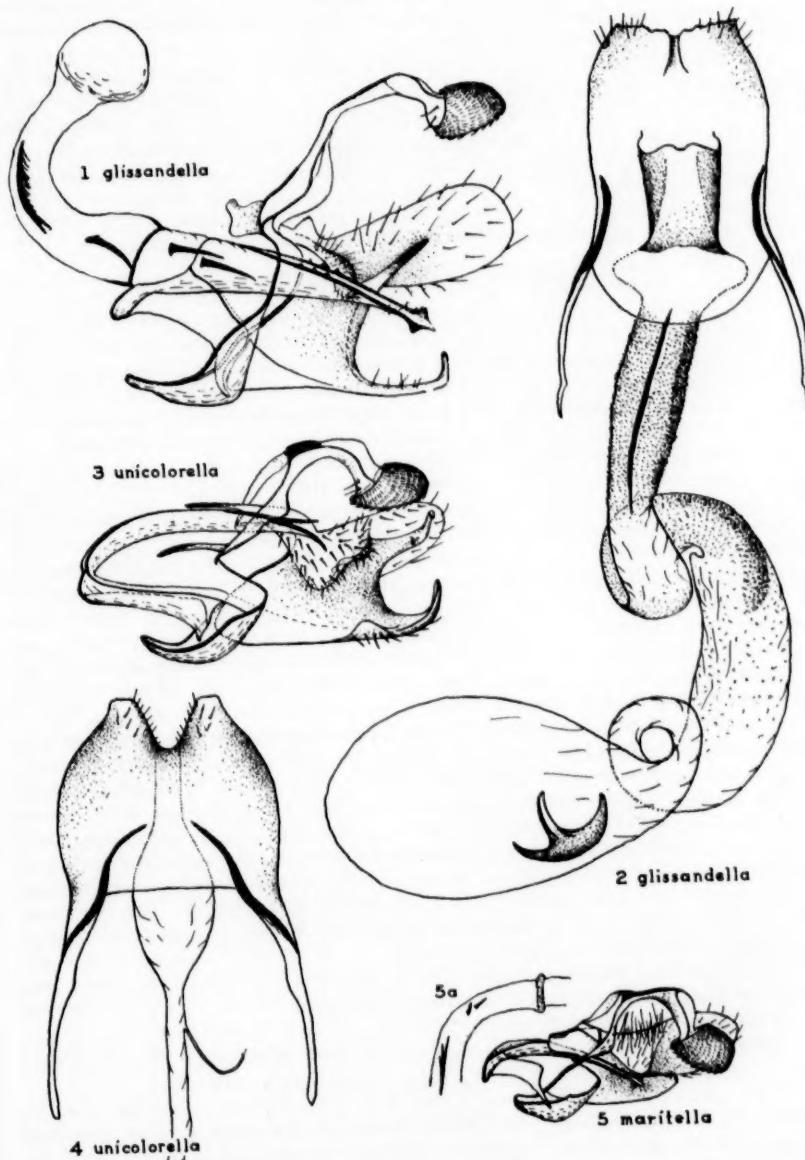
Glaucicolella was abundant at Bathurst, N. B., around *Juncus littoralis* and also near Caraquet, N. B., on *J. compactus*. In the last days of June and the first ones of July at Brackley Beach, P. E. I., its flight was evidently at its height in the marshy areas behind the sand dunes where *J. littoralis* grew profusely. At the same time as adults were being collected cases of a Coleophorid were found attached to the *Juncus* flowers on which the larvae were feeding; from such cases a series of adults was bred, emergence taking place in late July and early August. On closer study the genitalia of these specimens proved identical with those of the earlier, captured series; in maculation, beyond a slight deepening of the brownish suffusion, no differences could be detected. It would seem as if a large proportion of *glaucicolella* larvae hibernate full grown, pupate in the spring of the following year and emerge as adults at the time of the flowering of *Juncus*. Certain ones, however, hibernate when half-grown, possibly due to the drying up of the *Juncus* seeds; these feed up on the flowers in the spring and emerge a month later than the main spring brood. This would correspond with observations made by British entomologists on the appearance of *glaucicolella* throughout the summer and on the variation in depth of coloration of the fore wings.

Coleophora maritella McD.

Coleophora maritella McDunnough, 1941, Can. Ent., LXXIII, 91.

The original description was based on the female sex alone. Both sexes were present in almost unbelievable numbers on the flower-heads of *Juncus*

PLATE XIII.



GENITALIA OF MARITIME COLEOPHORIDAE

littoralis at both Bathurst and Brackley Beach and one sweep of the net was frequently sufficient to secure a series of specimens. The tiny, 6 mm. males are essentially the same as the females in metallic color and simple, pale tipped antennae. The male genitalia show great similarity with those of the *ericoides* group and lead to the belief that the grouping of the metallic-winged species into a single section is probably artificial.

Male Genitalia. (Fig. 5). Sacculus with ventral margin gradually rounded, without inward projection; caudal margin very feebly dentate and provided with a slightly larger tooth at the junction with the dorsal edge. Clasper large and projecting far beyond sacculus. Valvula subtriangular and provided with very long hair. Aedeagus with each lateral rod provided with a flat, triangular, apical tooth, behind which are two pairs of very minute teeth (possibly not always present). Vesica with a proximal group of several thin, closely appressed cornuti, distad to which are two single, short cornuti, placed obliquely.

Coleophora glissandella n. sp.

Very similar to *glaucicolella* Wood but the color of primaries is a more even light fawn brown, with little evidence of darker streaking between the veins, except very slightly in the apical area. The costa is narrowly and contrastingly pale creamy-white, this color frequently extending on to the apical fringes. Antennae with basal joint only slightly thickened and untufted, of a pale fawn color; balance of antennae rather definitely annulate with white and brown, especially in the female. Palpi with only slight ventro-apical tuft on second joint.

Male Genitalia. (Fig. 1). Abundantly distinct from that of *glaucicolella*. Sacculus with a narrow, pointed, dorsal process, similar to that of *glaucicolella* and *latronella*; the ventral edge, however, is drawn out into a long, flat, narrow process with upturned apex, somewhat resembling a ski. Clasper long, extending well beyond apex of sacculus; valvula reduced, with somewhat raised outer edge, and well clothed with hairs. Aedeagus with a pair of flat, triangular, apical teeth and two or three (the number seems variable) very small upright teeth on each lateral rod near its base. Vesica with a cluster of fine appressed spines basally, followed distad by three much larger isolated cornuti.

Female Genitalia. (Fig. 2). Genital plate forming a long rectangle with slightly convex sides; caudal margin rather straight and somewhat irregular, the two lobes separated by a slight median groove, much as in *latronella*. Ostium placed centrally on the plate, forming a raised chitinized rectangle with slightly sinuate caudal edge. The ductus bursae is expanded laterally at its inception, then quickly narrowed to a strongly spiculate tube with central chitinous band; a short membranous section follows which forms a half convolution and expands into a broad, curving section, heavily spiculate proximally; this, in turn, leads into the bursa after a single convolution. Bursa armed with a large, anchor-shaped signum. Expanse 11-12 mm.

Holotype—♂, Bathurst, N. B., June 26, 1941, (J. McDunnough); No. 5262 in the Canadian National Collection, Ottawa.

Allotype—♀, same data.

Paratypes—5 ♂, 3 ♀, same data (J. McDunnough or T. N. Freeman); 14 ♂, 10 ♀, Brackley Beach, P. E. I., June 29, 30 (same collectors).

The species was taken flying along with *glaucicolella* around *Juncus littoralis*. Superficially it is best differentiated by the more even and darker coloration of the primaries, together with the narrow whitish costal border. The males are easily separated on genitalia, the upcurved ventral projections of the sacculus being readily seen under the binocular; the females are more difficult to determine without making a slide as the caudal margin of the genital plate (frequently the only portion visible) is very similar to that of *glaucicolella*;

the more strongly annulate antennae are, in such cases, often a satisfactory character. It would seem to be allied to the European *alticolella* Zell, judging by Barasch's remarks on the genitalia. The larva is evidently a *Juncus*-feeder as a dwarfed, tattered male specimen from Sackville, N. B., bred by one of our officers from a case on *Juncus*, is in our collection. A case which I have frequently found but never bred may be the case of this species as it is the only one I have not yet associated. Such cases are cigar-shaped, rather chunky (but not as chunky as the case of *unicolorella*), covered with small granules and lying nearly flat on the object to which they are attached.

The species is evidently wide-spread as there are two males before me from Indian Head, Sask., and I have seen cases corresponding to those mentioned above on *Juncus* in the Ottawa region.

Coleophora unicolorella Cham.

Coleophora unicolorella Chambers, 1874, Can. Ent. VI, 129; Braun, 1914, Jour. Cin. Soc. Nat. Hist. XXI, 163; Heinrich (in Forbes, Lep. N. Y.) 1924, Mem. 68, Corn. Agr. Exp. Sta. 206, 209.

Cases corresponding to Dr. Braun's figure were first seen in 1940; they were quite numerous along the lanes on *Juncus tenuis* and also occurred on roadsides, together with the cases of *cratipennella*, on *J. compactus*; we were unsuccessful in securing imagoes from cases brought back to Ottawa.

In 1941, during the first week of July, adults were found to be numerous and evidently just emerging around a large patch of *J. compactus* on the main road from Brackley Beach to Charlottetown; they were best secured by gently sweeping the *Juncus* with the net in the early evening after sundown. A few cases were found in the trash at the bases of the *Juncus* plants and some of these produced adults. The interesting male genitalia, of which a figure is given, show relationship on the one hand to *glaucicolella* Wood and on the other to *fagicorticella* Cham.

Male Genitalia. (Fig. 3). Sacculus large, the ventral edge produced into a broad process, upcurved apically, something like the runner of an old-fashioned sleigh; the dorsal edge is produced into a thin, oblique, somewhat sinuate process, directed caudo-dorsally and with shortly recurved apex; this process is provided with a small spine in its central area. Clasper rather narrow, short, only slightly exceeding the apex of the dorsal process of the sacculus; valvula large, subtriangular, provided with numerous hairs. Aedeagus unarmed, the two lateral, chitinized rods somewhat divergent at apex and tapering to blunt points, that on the left side somewhat downcurved; both rods are short and do not nearly attain the outer edge of sacculus. Vesica unarmed.

Female Genitalia. (Fig. 4.) Rather simple. Genital plate roughly rectangular with convex lateral margins. On the caudal edge a broad central V-shaped incision forms the ostium, leaving a broadly truncate, slightly setose lobe on each side. The finely membranous ductus bursae forms a moderately wide tube for a short distance, then expands into an oval sac which extends somewhat beyond the cephalic edge of the genital plate. Beyond this again the ductus is straight and narrow, giving rise proximally to the ductus seminalis and ending distally in the unarmed bursa.

Coleophora fagicorticella Cham.

Coleophora fagicorticella McDunnough, 1940, Trans. Roy. Soc. Can. Sec. V, 65, Pl. II, fig. 4.

Occurred commonly at Brackley Beach on *Juncus compactus* along with *cratipennella* and *unicolorella*; also taken along many of the side roads wherever the food-plant was growing. Several of the characteristic cases, as figured by Dr. Braun, found among the trash at the bases of growing plants, produced adults.

At Guysboro, N. S., in the middle of July, it was still plentiful around the same plant, but rather worn.

EXPLANATION OF PLATE XIII.

1. *Coleophora glissandella* n. sp. Male Genitalia (left clasper removed); Paratype, Brackley Beach, P. E. I.
2. *Coleophora glissandella* n. sp. Female Genitalia; Paratype, Brackley Beach, P. E. I.
3. *Coleophora unicolorella* Cham. Male Genitalia (left clasper removed); Brackley Beach, P. E. I.
4. *Coleophora unicolorella* Cham. Female Genitalia; Brackley Beach, P. E. I.
5. *Coleophora maritella* McD. Male Genitalia (left clasper removed); Bathurst, N. B.

THE AMERICAN SPECIES OF *ENTOMOSCELIS* AND *HIPPURIPHILA*
(COLEOPTERA, CHRYSOMELIDAE)*

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***Entomoscelis adonidis* Pallas**

Authors have followed Kirby in referring American specimens of *Entomoscelis* Chev. to the Eurasian *adonidis* Pallas.. One female, without label, and two male examples of *adonidis* from the Elbruz Mountains of northwestern Persia are before me, and they differ from American specimens, which are described below as *americana* n. sp., in the form of the aedeagus and in slight characters of color and sculpture. *E. adonidis* is said to occur from southern France and Germany to Persia and southern Siberia. There is no reason at present to believe that its distribution is continuous with that of the American form.

***Entomoscelis americana* n. sp.**

Phaedon Adonidis Pallas, Kirby, 1837. Richardson's Fauna Boreali Americana, 214.
Entomoscelis adonidis of American authors.

The blackish spot of each side of the pronotum rarely as large as in *adonidis* Pallas, sometimes subobsolete but always evident. The submedian vitta of each elytron never wider than the interval separating it from the suture and thus nearly always narrower than in *adonidis*, occasionally greatly reduced or subobsolete. Punctures of the pronotum, metasternum, abdomen, and usually of the elytra, a little sparser than in *adonidis*. Aedeagus with the portion distad the sub-basal arcuation much more elongate than in *adonidis*; the arcuation at basal third in *adonidis*, at basal fourth in *americana*.

Other characters as in *adonidis*. The form and color pattern as figured by Chittenden (1902) and Fletcher (1905). Length of males 6.7 to 8.3 mm., of females 7.5 to 9.5 mm. Head red above, the mouth parts, clypeus, areas before and behind the eyes, and a small spot on the median line at base blackish; pronotum with a broad median area and a small spot on each side blackish; the dark median area widest at base, occupying about two-fifths of the disk; scutellum blackish; elytra red, each with the sutural margin very narrowly blackish except near the scutellum and with a blackish submedian vitta that fails to attain the base and apex. Appendages and body beneath blackish, the genae in part and the sides of the prothorax red.

Tarsi, especially the anterior and middle pairs, wider in the male than

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in the female. Apical abdominal segment flattened at middle and with the apical margin bisinuate in the male, simply truncate in the female.

Holotype—♂, Attoms Lake (near Cut Knife), Sask., Aug. 23, 1940 (A. R. Brooks); No. 5306 in the Canadian National Collection, Ottawa.

Allotype—♀, same data.

Paratypes—1 ♂, 6 ♀, same data; 1 ♀, Carcross, Y. T., July 28, 1919 (A. P. Hawes); 2 ♂, 3 ♀, Rolla, B. C., July 1, 1927 (P. N. Vroom); 1 ♂, Canim Lake, B. C., June 22, 1938 (G. S. Walley); 1 ♂, Vernon, B. C., June 21, 1919 (E. P. Venables); 1 ♂, 1 ♀, Spences Bridge, B. C., June 26, 1914 (Tom Wilson); 3 ♂, Nicola, B. C., July 29, 1923 (P. N. Vroom); 1 ♀, Smithers, B. C., July 7, 1924 (E. R. Buckell); 1 ♂, Newgate, B. C., July 9, 1936 (A. A. Dennys); 1 ♂, Cranbrook, B. C., July 20, 1928 (A. A. Dennys); 2 ♂, 5 ♀, Prince George, B. C., August, 1929 (Travis); 1 ♂, Ft. George, B. C., Aug. 2, 1915; 1 ♂, Ashcroft, B. C., June 23, 1920 (V. Richmond); 1 ♀, Ootsa Lake, B. C., July 6, 1924 (E. R. Buckell); 1 ♂, Crows Nest Pass, B. C.; 1 ♀, Lesser Slave Lake, Alta., Aug. 12, 1915 (J. M. Swaine); 2 ♂, Shaftsbury, Alta., Aug. 18, 1915 (E. H. Strickland); 1 ♂, Waterton, Alta., July 14, 1923 (H. L. Seamans); 1 ♂, Beaver Lake, Alta., 1907 (A. Halkett); 1 ♀, Blairmore, Alta., Aug. 15, 1930 (J. H. Pepper); 1 ♂, Spirit River, Alta., Aug. 20, 1915 (E. H. Strickland); 1 ♂, 1 ♀, Banff, Alta., August, 1927, and Sept. 26, 1922 (C. B. D. Garrett); 1 ♀, Rosthern, Sask., June 26, 1923 (K. M. King); 1 ♂, 1 ♀, Maryfield, Sask., Aug. 31, 1916 (N. Criddle); 1 ♂, Waskesiu Lake, Sask., July 10, 1939 (A. R. Brooks); 1 ♂, Souris, Man., August, 1900 (R. S. Crisp); 1 ♂, Aweme, Man., Aug. 9, 1909 (E. Criddle).

This species has not been reported from coastal districts of the Pacific. Judging by the localities listed above and by the numerous records of the Canadian Insect Pest Survey, it occupies in Canada a large, triangular area limited roughly by the Coast Range of British Columbia, the International Boundary, and by a line extending from Dawson, Yukon Territory, to south-central Manitoba. It has been reported from Nenana, Alaska, and from Washington, Montana, Utah, Colorado, and Minnesota. As a pest, the species is important to cruciferous crops in Canada but has attracted little attention in the United States. According to Fletcher (1900, 1905) it feeds on cruciferous plants only, attacking them generally but preferring *Sisymbrium incisum* Engelm. and *Erysimum parviflorum* Nutt., and Criddle (1912) has stated that *E. parviflorum* is its native food plant in southern Manitoba. Others have reported it a pest of beans and spinach, but its relation to these plants is unknown. The life history is evidently very similar to that of *adonidis* and has been described by Fletcher (1893) and Chittenden (1902).

Hippuriphila Foudras

Study of the material in our collection has shown that three species of *Hippuriphila* occur in Canada. All of these are distinct from the European *modeeri* L., and the names *mancula* Lec. and *equiseti* Beller and Hatch are available for two of them. It appears that *modeeri* is restricted to Europe and Asia and that American specimens which have been referred to *modeeri* should be referred to *mancula* and to *canadensis* n. sp.

In addition to the four species discussed below, one other, *laevicollis* Hellen of northern Finland and Siberia, has been placed in the genus. All of the species except *mancula* have been associated by authors with *Equisetum* L., and it would appear that all species restrict their feeding to that genus. None of them have been recorded from *Hippuris* L., although their generic name suggests that this genus serves as their host. However, Frost (1924) states that *Hippuriphila* mines the leaves of *Rumex crispus* L. and *R. obtusifolius* L., and

Needham, Frost, and Tothill (1928) state that the species "feed on docks (*Rumex*)". I suspect that these statements refer properly to *Mantura floridana* Crotch, a leaf mining species that occurs abundantly on *Rumex* in eastern America.

All of the species of *Hippuriphila* are largely or entirely piceous and bronzed and are from 2 to 2.6 mm. in length. They differ from the species of allied genera in having the tarsal claws not appendiculate, the sides of the meso- and metathorax and of the abdomen densely pubescent, and the first segment of each anterior tarsus enlarged in the males.

I am indebted to Dr. Melville H. Hatch for topotypical specimens of *equiseti* and to Dr. George M. Stirrett for specimens of most of the species.

KEY TO SPECIES

1. Elytra uniformly piceous, with a bronze luster. Truncation of each anterior prothoracic angle very well developed (fig. 1), its length equal to one and one-half times the length of the second antennal segment. Western Washington and British Columbia *equiseti* Beller and Hatch
2. Elytra piceous and bronzed but with the apical declivity yellow. Truncation of each anterior prothoracic angle feebly developed, its length not as great as the length of the second antennal segment 2.
2. Prothorax (fig. 2) more strongly transverse, its length equaling 61 to 65 per cent of its width, its lateral margins converging more strongly before the apex. Lateral margins of the elytra evenly arcuate from base to apex. Aedeagus (fig. 6) not arcuate. Europe and Asia *modeeri* (L.)
3. Prothorax a little less strongly transverse, the lateral margins converging less strongly before the apex. Lateral margins of the elytra subparallel basally. Aedeagus feebly arcuate 3.
3. Prothorax a little more strongly transverse. Lateral margins of the elytra slightly less strongly arcuate at apical third. Apex of the aedeagus bluntly pointed (fig. 7). Washington, British Columbia, and Alberta *mancula* (Lec.)
- Prothorax a little less transverse. Hind body slightly more robust, the lateral margins of the elytra slightly more strongly arcuate at apical third. Apex of the aedeagus broadly rounded (fig. 8). Quebec to Saskatchewan *canadensis* n. sp.

Hippuriphila equiseti Beller & Hatch

Hippuriphila equiseti Beller & Hatch, 1932, Univ. of Washington Publ. Biol., I, 127.

Prothorax (fig. 1) less strongly transverse, its length equaling 67 to 71 per cent of its width, the body form otherwise as in *modeeri*. Truncation of each anterior prothoracic angle strongly developed, its length equal to one and one-half times the length of the second antennal segment. Elytra (fig. 1) not paler apically, with their lateral margins evenly arcuate from base to apex as in *modeeri*. Antennae paler than in the other species, yellow, each segment except the basal four or five sometimes dark in part. Posterior femora stout, the width of each equaling 45 or 46 per cent of the length.

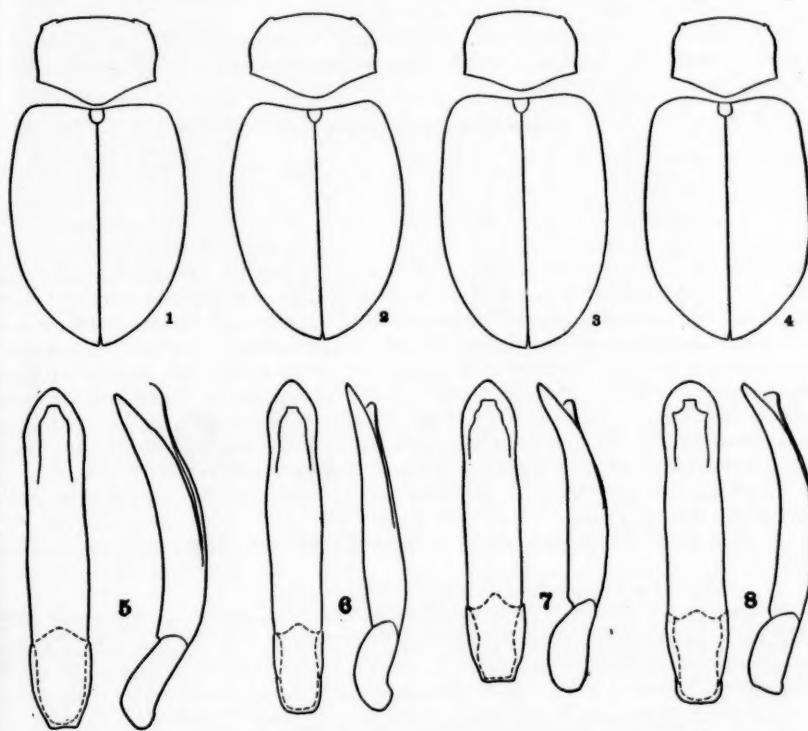
Aedeagus (fig. 5) similar to that of *mancula*, bluntly pointed as in *modeeri*.

Five males and seven females from Seattle, Sultan, and Snoqualmie Falls, Washington, and from Agassiz and New Westminster, British Columbia; the type of the species was taken at Seattle, and Beller and Hatch have recorded specimens from several other localities in western Washington.

Hippuriphila modeeri (L.)

Chrysomela Modeeri Linnaeus, 1761, Fauna Suecica, 167.

Body more evenly elliptic than in the other species. Prothorax (fig. 2) more strongly transverse and more strongly narrowed anteriorly than in the others, its length equaling 61 to 65 per cent of its width; the truncation of each anterior angle reduced to a mere thickening of the margin, its length less than



Pronota and elytra of *Hippuriphila* in dorsal aspect. 1. *H. equiseti* B. & H. 2. *H. modeeri* (L.); 3. *H. mancula* (Lec.). 4. *H. canadensis* n. sp.
Aedeagi of *Hippuriphila* in dorsal and lateral aspects. 5. *H. equiseti* B. & H. 6. *H. modeeri* (L.). 7. *H. mancula* (Lec.). 8. *H. canadensis* n. sp.

that of the second antennal segment. Elytra (fig. 2) with the lateral margins evenly arcuate from base to apex, the apical declivity yellow. Antennae with the basal segments yellow, the median and apical segments brown. Posterior femora stouter than in the other species, the width of each equal to 50 or 51 per cent of the length.

Aedeagus (fig. 6) bluntly pointed, a little more slender than in the other species, not arcuate as in the other species.

Two males and one female from England and Hungary.

Hippuriphila mancula (Lec.)

Haltica (Crepidodera) mancula LeConte, 1861, Proc. Acad. Nat. Sci. Philadelphia, 358.
Crepidodera modeeri, Horn (1889, Trans. Amer. Ent. Soc., XVI, 242) and other American
authors, in part.
Hippuriphila modeeri, American authors, in part.

Prothorax (fig. 3) less strongly transverse than in *modeeri*, its length equaling 68 to 71 per cent of its width, these proportions as in *equiseti*; the truncation of each anterior prothoracic angle reduced as in *modeeri* and *canadensis*. Elytra (fig. 3) with the lateral margins subparallel basally as in *canadensis* but less strongly arcuate apically as in *modeeri* and *equiseti*, the apical declivity yellow. Each antenna with the four or five basal segments yellow, the others dark. Posterior femora moderately stout, the width of each equaling 42 to 45 per cent of the length.

Aedeagus (fig. 7) similar to that of *equiseti*.

Fourteen specimens from Agassiz and Creston, British Columbia, and Banff, Alberta; the type was taken "East of Fort Colville", which is situated in Stevens County, Washington.

Hippuriphila canadensis n. sp.

Crepidodera modeeri, Horn (1889, Trans. Amer. Ent. Soc., XVI, 242) and other American authors, in part.

Hippuriphila modeeri, American authors, in part.

Length 2 to 2.6 mm. Body sculptured as in the other species; the prothorax (fig. 4) less strongly transverse than in the other species, its length equaling 71 to 74 per cent of its width; the truncation of each anterior prothoracic angle reduced as in *modeeri* and *mancula*, its length not as great as the length of the second antennal segment. Hind body a little more robust than in *mancula*, the lateral margins of the elytra subparallel basally as in *mancula* but converging more strongly apically than in that species; the apical declivity of the elytra yellow. Each antenna usually with four or five basal segments yellow, the other segments dark. Legs brown or brownish yellow, the femora sometimes darker; the posterior femora a little more slender than in the other species, the width of each equaling 39 to 42 per cent of the length.

Aedeagus (fig. 8) with its apex much more broadly rounded than in any of the other species.

Holotype—♂, Ottawa, Ontario, May 6, 1941 (W. J. Brown); swept from *Equisetum*.

Allotype—♀, same data.

Paratypes—8 ♂, 16 ♀, same data; 4 ♂, 1 ♀, same data, April 30, 1942; 1 ♀, Rimouski, Que., June 8, 1939 (W. J. Brown); 1 ♂, Knowlton, Que., June 5, 1930 (L. J. Milne); 3 ♂, 3 ♀, Knowlton Landing, Que., July 10, 1927 (W. J. Brown); 1 ♂, 4 ♀, Delhi, Ont., June 2 and 3, 1931 (W. J. Brown); 3 ♀, Riding Mountain Park, Man., June 9, 1937 (W. J. Brown); 1 ♂, 3 ♀, Churchill, Man., Aug. 2-9, 1937 (D. G. Denning); 1 ♀, The Pas, Man., Aug. 11, 1937 (D. G. Dennihg); 2 ♀, Roche Percée, Sask., July 4-6, 1927 (E. & S. Criddle).

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